UNIVERSITY OF SOUTHERN QUEENSLAND

Variability and Change of the Indo-Pacific Climate System and their Impacts upon Australia Rainfall

A Dissertation submitted by

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Abstract

Australia is one of the driest continents in the world, and over the past decades, severe drought has plagued most of the country. Water security is an important national issue. The ultimate water supply, rainfall, however, is one of the most variable ones in the world and is complicated by the fact that it is affected by several remote ocean-atmospheric teleconnection systems simultaneously, including the El Niño-Southern Oscillation, the Indian Ocean Dipole and Southern Hemisphere oceanic and atmospheric variability. These three systems sometimes conspire to produce a severe impact, whereas sometimes they offset each other to produce a mild influence. The recent severe water shortage has generated a surge of investments with strong regional applications. The present study focuses on areas and issues outside the scope of these regional studies, aiming to provide an Australia-wide assessment of future Australian rainfall under climate change. Firstly, we unravel a process of the Indo-Pacific oceanic teleconnection and examine its role in influencing variability of the Indian Ocean, and hence Australian rainfall variations. An examination of their contribution to the warming structure of the Indian Ocean is carried out. Secondly, we explore dynamics of North West Australian rainfall variability and mechanisms of a rainfall increase over the past decades, and benchmark climate models in terms of their ability to reproduce the observed variability and trends, focusing on the role of increasing northern hemispheric aerosols in the rainfall increase. Thirdly, we provide a dynamical explanation to the common future of a fast Tasman Sea warming rate under climate change, and identify the impacts of such warming on Australian rainfall. Finally, we examine the relative importance of the three systems, in addition to Tasman Sea warming, in driving rainfall changes under greenhouse conditions. This project contributes to no less than six peer-reviewed journal publications.

Certification of Dissertation

I certify that the ideas, experimental, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

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Signature of Candidate Date

ENDORSEMENT

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Signature of Supervisor/s Date

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